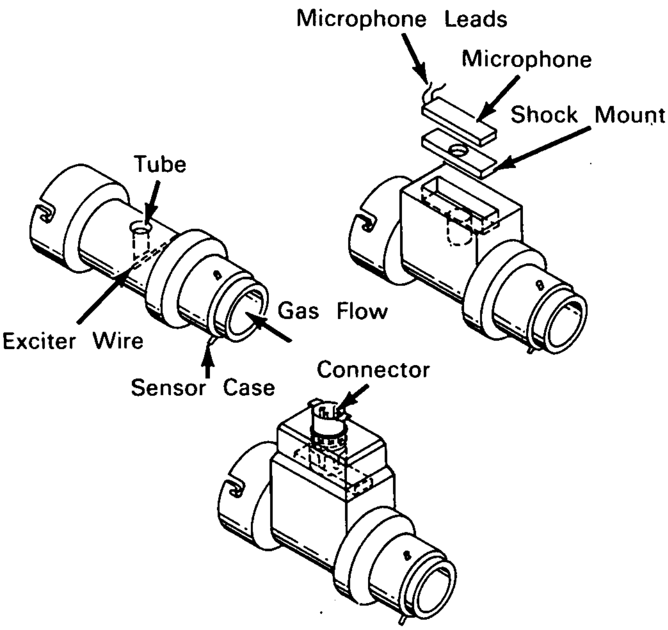
NASA TECH BRIEF

High- and Low-Pressure Pneumotachometers Measure Respiration Rates Accurately in Adverse Environments



LOW PRESSURE PNEUMOTACHOMETER

The problem:

To medically monitor a subject, performing a variety of operations while piloting a high performance research aircraft, poses many problems since noise levels are high, vibration and acceleration levels are excessive, and the subject must be relatively active. For example, respiration rates, which provide valuable physiological function data, have been the subject of much research. Techniques used to date have been less than ideal since they suffer degradation from subject activity, noise and vibration, and thermal disturbances. They also impose power penalties on systems that are critically loaded to begin with.

The solution:

Respiration-rate transducers in the form of pneumotachometers that monitor either low pressure or high pressure oxygen systems. In each system the sensor is placed in series with the pilot's oxygen supply line to detect gas flow accompanying respiration.

How it's done:

In the low pressure application, a sensor case is fabricated with a coupling at each end to permit its insertion into the oxygen flow line. The body is machined to receive a small tube, shock mount, and subminiature ceramic microphone. The tube is in

(continued overleaf)

intimate contact with the oxygen flow at one end and the ceramic microphone at the other, while the shock mount serves to isolate the microphone from aircraft vibration. An exciter wire is interposed between the entry port and exit port of the sensor case at a point between the entry port and microphone tube. When the subject inspires, oxygen encounters the exciter wire and turbulence is introduced into its flow as it passes the lower end of the microphone tube. This turbulence gives rise to an audio signal that is detected by the microphone and converted to a voltage proportional to signal amplitude. Microphone output is amplified and fed to an appropriate storage or readout medium.

Notes:

1. In the high pressure application, as illustrated below, when the subject inspires, oxygen passes through the inlet port, out through the escape hole into the sensor chamber, and exits through the outlet port to the subject's oxygen line. As oxygen leaves the escape hole it strikes the microphone diaphragm before exiting by the outlet port. The diaphragm is thus modulated by the passage of oxygen to produce a signal that is directly proportional to the subject's inspiration rate and amplitude.
2. Further information concerning this invention is presented in NASA TN D-4217, "Development of Respiration Rate Transducers for Aircraft Environments" by Robert T. McDonald and James Roman, October 1967, available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151; price $3.00. Inquiries may also be directed to:

   Technology Utilization Officer
   Flight Research Center
   Post Office Box 273
   Edwards, California 93523
   Reference: B68-10188

Patent status:

This invention is owned by NASA, and a patent application has been filed. Royalty-free, nonexclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

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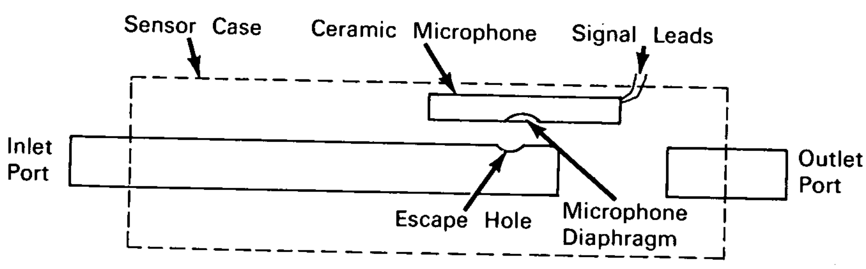

HIGH PRESSURE PNEUMOTACHOMETER